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REPORT

Predictors of Multiple Births and Infant Deaths in Alberta

Alberta

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TABLE OF CONTENTS

1 EXECUTIVE SUMMARY

Records of multiple births (twins, triplets, and higher order births) and infant deaths (deaths of liveborn infants prior to one year of age) in the province of Alberta between 1997 and 2004 were analyzed. It is critical that understanding of the factors related to these two important outcomes of live births in Alberta is furthered. Multiple births are at increased risk of morbidity and mortality, and the multiple birth rate is increasing in Alberta. Infant death is among the most devastating possible events in the lifetime of a family. Close scrutiny of factors related to infant death may help discern strategies to prevent some deaths.

Associations between a number of maternal and infant indicators and these two outcomes were considered. The goal was to understand the differing influences of the maternal and infant indicators, with a particular emphasis on potentially modifiable factors.

Multiple Births

Multiple birth, while usually safe, is clearly associated with increased rates of mortality and morbidity: Multiples are much more likely to die or require special care in infancy than singletons. From a public health perspective, prevention of multiple pregnancies is in the best interests of mothers and babies.

Low birth weight and preterm birth were strongly associated with multiple birth in the present analysis, as were interventions such as cesarean section delivery and induced labour. Mothers with multiple pregnancies required and received more prenatal care on average than mothers of singletons. These findings are not unexpected, given the known risks associated with multiple birth.

The analysis highlighted delayed childbearing as a potentially modifiable risk factor for multiple birth. The risk of having a multiple pregnancy is higher for mothers over 34 years of age as fertility declines. It is also well established that fertility treatments are associated with a high rate of multiple birth. Avoidance of delayed childbearing and reproductive technologies resulting in multiple fetuses will reduce the multiple birth rate, and hence related mortality and morbidity.

1 EXECUTIVE SUMMARY (continued)

Infant Deaths

The babies most likely to die in infancy are low birth weight (especially <1,500 grams), but congenital anomalies and mother's previous history of infant death are also strong predictors of death before one year of age.

Modifiable factors which affect risk of infant death include birth to mothers under the age of 20 years (linked to higher rates of infant death), and prenatal care (visits with physicians and midwives and attendance at prenatal classes), which is linked to reduction in the odds of infant death. Because of the role of low birth weight and congenital anomalies, any measures which prevent these outcomes are expected to reduce the risk of infant death.

Summary

Delayed childbearing and the use of fertility treatments are leading to a dramatic increase in the number of multiple births in Alberta. It is imperative that women and men of childbearing age be counseled about the risks associated with multiple births, and be made aware that the risk of giving birth to multiples is higher for older mothers and when fertility treatments are used.

Infant deaths are preventable in some cases. Programs designed to prevent teen pregnancies can help reduce the higher risk of infant death associated with teen pregnancy. Regular, high quality prenatal care that is readily available to all women allows better monitoring of conditions and risk factors that may lead to eventual infant death. Women least likely to be engaged in care, including those with language barriers, low incomes, low literacy and mental health challenges, are most likely to benefit from prenatal care services.[1,2]

2 INTRODUCTION

2.1 Background

Although multiple births (twins, triplets, or higher order births) are relatively rare, they account for a disproportionate amount of maternal and infant morbidity and infant mortality. While the preterm birth rate among singletons in Alberta was 7.2% of live births between 2003 and 2005, the preterm rate for multiples was 58.7% during that time period—an eight-fold difference. The low birth weight rate among multiples was more than 10 times higher than among singletons—low birth weight infants constituted 4.9% of liveborn singletons and 53.1% of liveborn multiples.[3]

The multiple birth rate in Alberta is increasing. In 1996, the rate was 2.4% of live births, and by 2005 the rate was 3.2% of live births, a 33% increase. This trend is thought to be due to increases in maternal age and use of fertility treatments, both of which are associated with higher multiple birth rates. Among a sample of Alberta women who had recently given birth to their first liveborn infant, 12.2% used some form of assisted reproductive technology.[4] In a study of almost 500 successful in vitro fertilization pregnancies among Alberta women, almost 50% were multiple pregnancies.[5] In Alberta mothers age 35 and older, one in twenty live births is a multiple birth. [3,6,7]

Infant death is a rare occurrence in Alberta, though not non-existent and certainly an important indicator for public health. In 2005, 276 infants died before reaching their first birthday in Alberta, a rate of 0.66%. Girls had a lower infant mortality rate (0.58%) than boys (0.75%). There was no time trend in infant mortality in Alberta between 1996 and 2005.[3]

The relative rarity of multiple births and infant deaths results in difficulties when it comes to studying risk factors for these outcomes. It is difficult to make reliable generalizations without population-level research. This is the major contribution of the current study: the database contains maternal and infant indicators for thousands of multiple births and infant deaths. The goal is to further understanding of the risk and protective factors for these important outcomes. The emphasis was on potentially modifiable factors, in the interest of promoting prevention efforts.

2 INTRODUCTION

2.2 Methodology

2.2.1 Data Sources

Vital Statistics Birth Registration Files

Live birth statistics were derived from Vital Statistics Birth Registration Files, managed by the Ministry of Service Alberta.

Registration of births via the Notice of Live Birth or Stillbirth form in Alberta is legally required, and the Birth Registration files are believed to be virtually complete. The Notice of Live Birth or Stillbirth form provides information about the infant, the birth, the infant's parents, maternal risk factors, and other demographic and health-related information.

All live births to Alberta residents registered by Alberta Vital Statistics between January 1, 1997 and December 31, 2004 were included in the study. This amounted to 304,161 live births. Births to non-Alberta residents occurring in Alberta were excluded, as were stillbirths.

Live births that result in death prior to one year of age have a code added to the record of live birth. Births with this code formed the database for the analysis of infant deaths.

Alberta Congenital Anomalies Surveillance System

Data on congenital anomalies were obtained from the Alberta Congenital Anomalies Surveillance System (ACASS). ACASS collects data for all infants who are diagnosed with a congenital anomaly prior to their first birthday. ACASS data were linked with the Vital Statistics Birth Registration files with the birth registration identifier, with over 99% successful linkage.

2 INTRODUCTION

2.2 Methodology

2.2.2 Data Analysis Methods

Logistic regression analysis was used to model multiple births (twins, triplets, or higher order) and infant deaths (live births with a code for subsequent infant death). Predictors included indicators available from the Birth Registration database (see Section 2.2.3).

The primary analysis outcome was odds ratios (OR). Odds ratios are the ratio of the odds of the occurrence of something in one group, to the odds of the same occurrence in another group. For example, the odds of multiple birth in mothers over 35 years of age might be twice as high as the odds of multiple birth in mothers between 20 and 34, for an odds ratio of 2.0. When the odds in the two groups are equal, the odds ratio is 1.0, meaning the risk (e.g., of multiple birth) is not greater in the "at risk" group (e.g., mothers 35 and older) than in the reference group (e.g., mothers 20 to 34 years old). Odds ratios greater than one indicate a higher risk than the reference group, while odds ratios less than one indicate a lower risk than the reference group. The natural log of odds ratios (logOR) is often taken to create symmetry of odds ratios above and below zero. For log odds ratios, values greater than 0 indicate higher risk, while values below 0 indicate reduced risk compared to the reference group.

All variables were simultaneously entered into each model. The adjusted odds ratio for a given indicator can be interpreted as the contribution of that variable to the birth outcome of interest, after the contributions of all of the other variables are accounted for. In other words, the adjusted odds ratios reflect the *independent* contributions of the indicators.

The odds ratio for a given indicator is expressed as percentage increase in the birth outcome. For example, the odds ratio for preterm birth in multiple births was 3.85. This means that the odds of multiple birth was 3.85 time higher in preterm births than in non-preterm births, after controlling for the effects of all other variables in the model.

Confidence intervals were used to assess the significance of odds ratios. Statistical estimates (such as means) are uncertain; the reported result of a statistical analysis is only the most likely result. A confidence interval tells us, with 95% certainty, the range within which the true value lies. For example, if an odds ratio estimate is 2.0, with a 95% confidence interval of 1.5 to 2.5, it can be said with 95% confidence that the true odds ratio is between 1.5 and 2.5.

2 INTRODUCTION

2.2 Methodology

2.2.2 Data Analysis Methods
(continued)

In order to keep as much data as possible in the models (to maintain statistical power), records with missing data were included as an additional category for each variable (although missing data categories do not appear in the tables). Bivariate comparisons of the missing groups to the reference groups indicated that missing values were more similar to risk groups than to reference categories. This makes the estimates of odds ratios conservative. If missing values were excluded, the odds ratios for risk groups would be more extreme (but with larger confidence intervals due to the decreased power of the analyses).

Interaction terms that were not significant were excluded from the models.

Figures show the log odds ratio for each of the indicators in a given analyses. Bars for odds ratios are colour- coded as follows: red for risk factors (log odds ratio of the birth outcome greater than 0 and confidence interval does not include 0), green for protective factors (log odds ratio of the birth outcome less than 0 and confidence interval does not contain 0), and grey for non-significant log odds ratios (confidence interval contains 0). The red and green bars are muted for non-modifiable factors, allowing the modifiable factors to stand out in the figures. Confidence intervals are plotted in light grey on the bars.

Tables include both adjusted odds ratios and log odds ratios.

Multiple Birth
Non-singleton birth of any order (twin, triplet, or higher).
Infant Death
Death of a liveborn infant prior to one year of age.
Sex
Sex of the infant: male or female.
Rural residence
Maternal postal code beginning with T0 denotes rural residence: yes or no. This variable is most likely a proxy for socioeconomic status (lower in rural areas in general) and/or First Nations status (higher in rural areas in general), although the true nature of this variable is not well understood. Caution in interpretation is advised.
Preterm Birth
Gestational age at birth of <37 weeks.
Birth Weight Group
Weight at birth: <1500 grams, 1,500 to 2,499 grams, 2,500 to 3,999 grams, or 4000+ grams.
Congenital anomaly
The births database was linked to the congenital anomalies database to determine whether an infant was diagnosed with a congenital anomaly at birth or within the first year of life: yes or no.
Maternal age
Age group of the mother in years at time of birth: <20, 20-34, or >34 years.
Parity
Total births (live + still) to the mother, including current birth: 1, 2, or >2. Parity is confounded with multiple birth status (for multiples, parity varies according to order of birth, so a firstborn twin has a lower parity than the secondborn twin). For this reason, parity was omitted from the multiple birth analysis.
Marital status
Whether the parents were married to each other at the time of birth: married to each other or not married to each other. This variable may have its effects in part due to socioeconomic status: parents who are married to each other are likely to have greater access to economic resources than parents not married to each other. Caution in interpretation is advised.
Previous abortions
Total previous aborted pregnancies, including spontaneous and induced abortions; 0 or 1+.
Previous stillbirths
Number of previous stillbirths for the mother: 0 or 1+.
Previous infant deaths
Number of previous infant deaths for the mother: 0 or 1+.

Onset of labour
Whether labour was spontaneous or induced.
Cesarean section
Whether delivery was by cesarean section or not.
Number of prenatal visits
Total number of visits with physicians or midwives during the pregnancy; <3 or 3+. Note that mothers giving birth preterm have less opportunity to attend prenatal visits, so this variable is confounded with gestational age.
Prenatal class attendance
Attendance at prenatal classes (of any kind) or not. As with number of prenatal visits, this number is expected to be confounded with gestational age due to opportunity to attend. Furthermore, prenatal class attendance is far more common with first births than with subsequent births, and is thus correlated with parity.
Maternal prenatal smoking
Cigarette smoking behaviour of mother during pregnancy: yes (including quitting during pregnancy) or no.
Maternal prenatal alcohol consumption
Alcohol consumption by mother at any point in pregnancy: yes or no.
Maternal prenatal street drug use
Use of street drugs at any point in pregnancy: yes or no.

2 INTRODUCTION

2.2 Methodology

2.2.3 Indicators
(continued)

2 Introduction

2.2 Methodology

2.2.4 Data Limitations

Data appearing in this report are subject to a number of limitations, and all readers are encouraged to consider this section carefully.

Restricted data set
The Birth Registrations database is limited to the variables that appear on the Notice of Live Birth and Stillbirth. A number of factors known to affect birth outcomes (e.g., maternal prenatal conditions, complications of pregnancy, previous obstetrical history, socioeconomic status, etc.) are not included in the current report.

Self-reported data
The data on the Notice of Live Birth or Stillbirth is collected via self-report from the mother, shortly after birth. As such, the data are subject to recall and social desirability biases. In particular, socially undesirable maternal behaviours such as prenatal substance use are expected to be underreported. History of induced abortion is also expected to be underreported. Number of prenatal visits is likely to be estimated by many mothers, who may not recall exact number of visits; direction of bias in such recall is unknown.

Missing data
As outlined in the data analysis section, missing values were included as an additional category for each indicator in order to maintain the power of the model. The results would be different if missing values had been excluded: odds ratios would be more extreme, but confidence intervals would be larger (due to reduced number of cases).

Previously published data
Data in this report may differ from that previously published due to differences in methodology and/or dates of data extraction.

3 Previous Findings

3.1 Multiple Births

Multiple pregnancies are a common outcome of fertility treatments such as embryo transfers or ovulation stimulation. They are also more common in older or obese mothers. [6,7,8]

Multiple pregnancies are higher risk for mothers than singleton pregnancies. Some of the risks of multiple pregnancy are cardiovascular problems, anemia, pre-eclampsia, gestational diabetes, postpartum hemorrhage, and operative delivery, including high rates of cesarean section.[9]

Babies are also at higher risk when they are part of a multiple birth. The mortality rate for multiples is generally several times that of singletons. The majority of multiples are low birth weight (whether due to restricted growth or preterm birth or both). Multiples also face the risk of umbilical cord entanglement and Twin-to-Twin Transfusion Syndrome. Congenital anomalies are more common in multiples than in singletons. Long-term disabilities known to occur in multiples more often than in singletons include: cerebral palsy, language development problems, behavioural disorders, challenges in school, and relationship difficulties. [3,10,11,12]

Multiples and their families face economic and psychosocial burdens unique to multiples.[13] These burdens are heightened by the high rates of morbidity among multiples.

Multiple birth rates in Canada and Alberta show increasing trends between 1995 and 2004. From 2000 to 2004, the rate was significantly higher in Alberta than in Canada every year, with the exception of 2003.[3]

3 PREVIOUS FINDINGS

3.2 Infant Deaths

The leading causes of infant mortality in Canada in 1999 were congenital anomalies (26.5%), immaturity (23.4%), sudden infant death syndrome (11.2%), and asphyxia (10.1%). [14]

Most infant deaths occur in babies who are preterm or low birth weight (or both). As indicated above, congenital anomalies also play a critical role in infant death rates. Maternal factors include prenatal smoking, low level of maternal education, low socioeconomic status, First Nations ethnicity, and either high or low maternal age. Infant deaths occur more often in boys than in girls.[15,16,17,18,19]

Canadian infant mortality rates declined in the late 1990s and then stabilized. In 2003, the infant mortality rate was 0.66% in Alberta and 0.53% in Canada. This difference is at least partially due to differences in birth registration practices. Registration of very small (<500 grams or <24 weeks gestation) live births is not consistent across the country, but is standard in Alberta. Because the mortality rate is very high in this birth weight group, Alberta's infant mortality rate is elevated relative to jurisdictions who do not consistently register the births of these infants. [20]

Though infant deaths are rare in Alberta, it is crucial to understand the risk factors for infant death. Infant death rates are an important indicator of the health of a population, and persistent surveillance is necessary to find and track trends that may not be obvious in small scale studies or to individual practitioners in the field. Furthermore, infant death is a devastating occurrence for families. Understanding of risk factors may help to prevent some of these tragedies.

4 RESULTS

4.1 Overall findings

The list of variables included in the models appears in Table 4.1.1, including the number and percent of live births in each category. See Section 2.2.3 for definitions of indicators.

The percentages in this table are based on the entire cohort of 304,161 live births to Alberta resident mothers between 1997 and 2004. Percentages do not add up to 100 in all cases due to missing data. Some indicators were quite rare and occurred in fewer than 5% of births (e.g., multiple birth, congenital anomaly, post-term gestation, birth weight under 1,500 grams, previous history of stillbirth, previous history of infant death, fewer than three prenatal visits, maternal prenatal alcohol consumption, and maternal prenatal street drug use). However, because of the large sample size, there were nevertheless thousands of births in these categories.

Year of birth was included in both models. In both cases, the effect of year was significantly greater than 1, reflecting the increasing multiple birth rate in Alberta between 1997 and 2004 and a small overall increase in the infant death rate between these years (as noted in the Background section, there is no significant time trend when 1996 is also included in the infant death data set. This demonstrates the tenuous nature of this effect). Year of birth was included only to control for changes in indicators over time, and does not appear in the tables or figures for the models.

Table 4.1.1. Number and Percentage of Live Births by Infant and Maternal Indicators, All Live Births in Alberta (N=304,161), 1997 to 2004

Indicator	Category	Number	% of live births
Sex	Male	155,657	51.2
	Female	148,502	48.8
Rural residence	Yes	52,981	17.4
	No	241,513	79.4
Multiple birth	Yes	9,075	3.0
	No	295,086	97.0
Congenital Anomaly	Yes	10,235	3.4
	No	293,926	96.6
Term (weeks)	Preterm (<37)	25,099	8.3
	Term (37 to 42)	278,886	91.7
	Postterm (>42)	160	0.1
Small-for-gestational-age	Yes	24,778	8.1
	No	279,383	91.9
Maternal age (years)	<20	18,960	6.2
	20 - 34	241,614	79.4
	>34	43,569	14.3
Parity	1	126,446	41.6
	2	103,622	34.1
	>2	74,089	24.4
Marital status of parents	Married to each other	219,109	72.0
	Not married to each other	85,052	28.0
Number of previous aborted pregnancies	0	218,203	71.7
	1+	85,958	28.3
Number of previous stillbirths	0	301,224	99.0
	1+	2,937	1.0
Number of previous infant deaths	0	301,224	99.0
	1+	2,937	1.0
Onset of labour	Induced	70,922	23.3
	Spontaneous	173,287	57.0
Cesarean section delivery	Yes	55,312	18.2
	No	175,885	57.8
Number of prenatal visits in term births[1]	<3	4,665	1.7
	3+	213,119	76.4
Attendance at prenatal classes in first time mothers[2]	Yes	64,679	51.2
	No	38,064	30.1
Maternal prenatal smoking	Yes, or quit during pregnancy	66,339	21.8
	No	214,328	70.5
Maternal prenatal alcohol consumption	Yes	11,626	3.8
	No	265,452	87.3
Maternal prenatal street drug use	Yes	5,185	1.7
	No	267,785	88.0
Maternal smoking and drinking alcohol	Both	7,028	2.3
	Neither	233,224	76.7
Maternal smoking and drug use	Both	4,224	1.4
	Neither	236,861	77.9
Maternal smoking at age 35 or over	Both	6,127	2.0
	Neither	200,380	65.9
First time mom at age 35 or over	Both	10,829	3.6
	Neither	144,975	47.7
Maternal smoking and first time mother	Both	27,595	9.1
	Neither	138,971	45.7
Maternal smoking, drinking and drug use	Yes	1,836	0.6
	No	232,556	76.5

Source: Vital Statistics Birth, Stillbirth, and Death Files, Service Alberta, November 2006 release.

Notes: 1. Prenatal visits are shown for term births only; mothers who give birth before term have less chance to attend prenatal visits.

2. Attendance at prenatal classes is shown for first time mothers only, as attendance drops off considerably after the first birth.

Missing values are included in the calculation of percentages in the table.

Data include Alberta residents only.

Data may differ from previously published data due to differences in definitions and dates of data extraction.

4 RESULTS

4.2 Multiple Births

In this model, odds ratios for multiple births (twins, triplets, and higher order births) were looked at. The 9,075 live multiple births that occurred to Alberta-resident mothers in Alberta between 1997 and 2004 represent 3.0% of the 304,161 live births occurring in that time period.

Due to the confound between parity and multiple birth (the mother's parity is different for the members of a multiple birth), parity was omitted from the multiple birth logistic regression model.

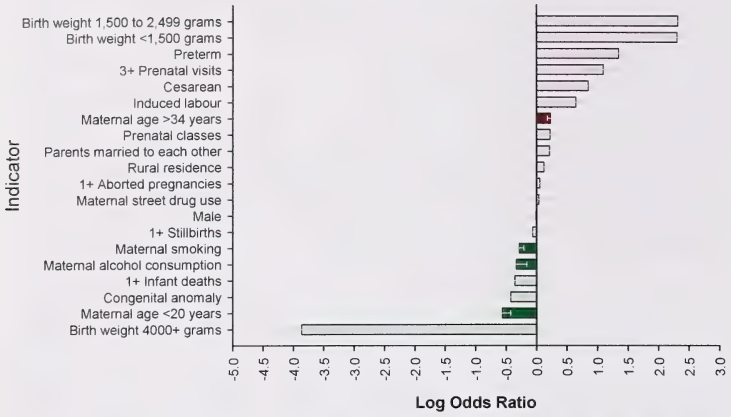
Unlike other potentially adverse outcomes (such as preterm birth or small-for-gestational-age births) for which causal factors may play a role either prior to or during gestation, multiple pregnancies are already determined at conception. Interpretation of a logistic regression model of the risk of multiple births must reflect this fact. Multiple births are not caused by factors that occur during gestation—the multiple pregnancy was already established when these factors occurred. Thus, the definition of "potentially modifiable" factors here shifts to indicators that play a role prior to conception. For example, prenatal visits and prenatal class attendance cannot play a causal role, because they occur after the multiple pregnancy is established. Modifying prenatal care variables will not mediate the risk of having a multiple birth. Maternal behaviours such as prenatal smoking, alcohol consumption, or street drug use are will only modify the occurrence of multiple pregnancies to the extent that prenatal engagement in these behaviours most likely is accompanied by pre-conception engagement (which may play a causal role).

Because multiple pregnancy is typically identified at fairly early stages of pregnancy, obstetrical care for the remainder of the pregnancy generally reflects knowledge of the increased risk that accompanies multiple birth. Thus, women with multiple births are expected to be more likely to have many prenatal visits and attend prenatal classes. The closer monitoring of their pregnancies also likely leads to greater rates of intervention such as induced labour prior to term.

4 RESULTS

4.2 Multiple Births

Figure 1. Indicators of Multiple Births, Alberta, 1997 to 2004



Source: Vital Statistics Birth, Stillbirth, and Death Files, Service Alberta, November 2006 release.

Logistic regression analysis of multiple births revealed that birth weight was clearly the strongest predictor of multiple births, with the largest risk of multiple birth in the <1,500 grams and 1,500 to 2,499 gram births (i.e., low birth weight babies), and the largest negative odds ratio (protective factor) being birth weight of 4,000 grams or more. Preterm birth was also strongly associated with multiple birth. (See Table 4.2.1; explanation of figure conventions appears in Section 2.2.2).

The rates of prenatal visits and attendance at prenatal classes were indeed higher in mothers giving birth to multiples, as would be expected in any pregnancy with known risk. Similarly, obstetrical interventions (induced labour and cesarean section) were associated with a higher risk of multiple birth.

Mothers over 34 years were at increased risk of multiple birth, and mothers under 20 years of age had a decreased risk. Maternal age is a potentially modifiable factor: Reduction of the risk of multiple birth can occur by avoiding delayed childbearing. The size of this reduction can only be determined by comparing infants conceived naturally to those conceived with the assistance of reproductive technologies, however. While the rate of multiple births conceived without assistance does increase with age, fertility also declines with age and it is older mothers who are far more likely to use reproductive technologies (which are more likely to result in multiple births). Data on the nature of conception of these infants were not available, so the role of reproductive technologies in the maternal age effect was not determined.

4.2 Multiple Births
(continued)

Interestingly, maternal prenatal alcohol consumption and maternal prenatal smoking were protective factors, with a decreased risk of multiple birth for these mothers. Without further study, it cannot be determined why this might be the case. While there may be some demographic factor that is correlated with these behaviours that is not controlled for in the model, it may also be the case that engaging in these behaviours prior to conception does indeed reduce the odds of a multiple conception. It is important that these findings not be interpreted as an endorsement of alcohol or tobacco use during pregnancy.

Other indicators had small but significant odds ratios. Parents who were married to each other had higher rates of multiple birth than parents not married to each other, likely reflecting the higher socioeconomic status of married couples, and thus increased likelihood of accessing reproductive technologies. The effect of rural residence likely also reflected socioeconomic status.

Presence of a congenital anomaly had a protective effect—multiple births were less likely with a congenital anomaly than when congenital anomalies were absent. This is contrary to the literature, which indicates that congenital anomaly rates are higher in multiple births than in singleton births. Interestingly, if birth weight is removed from the model, the odds ratio for congenital anomaly becomes positive (1.219, CI = 1.105-1.346). It appears birth weight plays an important role in the relationship between multiple birth and congenital anomaly. Further study is warranted.

Previous history of infant death was also associated with a decreased risk of multiple birth. Perhaps women who are giving birth to multiples are less likely to have had previous children and therefore cannot have had a previous infant death (multiple birth and nulliparity occur, for example, in older women who have been unable to conceive and seek reproductive assistance), or perhaps prior history of infant death means those women are indeed fertile and are less likely to seek reproductive assistance, leading to a lower multiple birth rate. These hypotheses could be tested if data on the method of conception, which is not currently part of the Birth Registration database, were available. Future research would do well to consider the relationship between previous infant death and multiple birth.

Multiple birth is associated with significant risks to mothers and their infants. Analysis of the indicators in the Births Registration dataset leads to the conclusion that the best ways to avoid multiple birth are to avoid delayed childbearing, as well as fertility treatments that result in multiple fetuses.

4 RESULTS

4.2 Multiple Births (continued)

Table 4.2.1. Rate, Adjusted Odds Ratios and Confidence Intervals, and Log Odds Ratios and Confidence Intervals for Multiple Births (n_{case}=9,075) in Live Births (N=304,161), by Infant and Maternal Indicators, Alberta, 1997 to 2004

Indicator	Category	Rate (%)	OR[1]	Lower 95% CI	Upper 95% CI	Log_e OR[2]	Lower 95% CI	Upper 95% CI
Sex	Male	2.9	1.00	0.95	1.04	-0.01	-0.05	0.04
	Female	3.1	1.00			0.00		
Rural residence	Yes	2.8	1.13	1.06	1.20	0.12	0.06	0.18
	No	3.0	1.00			0.00		
Preterm birth	Yes	20.5	3.85	3.58	4.14	1.35	1.28	1.42
	No	1.4	1.00			0.00		
Birthweight group	<1,500 grams	28.3	10.06	8.98	11.27	2.31	2.19	2.42
	1,500 to 2,499 grams	24.8	10.21	9.45	11.02	2.32	2.25	2.40
	2,500 to 3,999 grams	1.7	1.00			0.00		
	4000+ grams	0.0	0.02	0.01	0.03	-3.86	-4.42	-3.44
Congenital anomaly	Yes	5.0	0.66	0.59	0.73	-0.42	-0.53	-0.31
	No	2.9	1.00			0.00		
Maternal age (years)	<20	1.4	0.57	0.49	0.65	-0.56	-0.71	-0.43
	20 - 34	2.8	1.00			0.00		
	>34	4.5	1.26	1.19	1.34	0.23	0.17	0.29
Marital status of parents	Married to each other	3.2	1.24	1.17	1.32	0.22	0.16	0.28
	Not married to each other	2.3	1.00			0.00		
Number of previous aborted pregnancies	1+	3.4	1.06	1.01	1.12	0.06	0.01	0.11
	0	2.8	1.00			0.00		
Number of previous stillbirths	1+	4.3	0.94	0.82	1.09	-0.06	-0.20	0.09
	0	3.0	1.00			0.00		
Number of previous infant deaths	1+	5.0	0.70	0.58	0.85	-0.36	-0.54	-0.16
	0	3.0	1.00			0.00		
Number of prenatal visits	3+	2.9	3.00	2.37	3.79	1.10	0.86	1.33
	<3	3.3	1.00			0.00		
Attendance at prenatal classes	Yes	3.0	1.25	1.19	1.33	0.22	0.17	0.29
	No	3.0	1.00			0.00		
Onset of labour	Induced	3.2	1.91	1.80	2.03	0.65	0.59	0.71
	Spontaneous	2.0				0.00		
Cesarean section	Yes	7.5	2.34	2.21	2.48	0.85	0.79	0.91
	No	2.0				0.00		
Maternal prenatal smoking	Yes, or quit during pregnancy	2.4	0.75	0.71	0.81	-0.28	-0.34	-0.22
	No	3.2	1.00			0.00		
Maternal prenatal alcohol consumption	Yes	2.0	0.72	0.62	0.85	-0.33	-0.48	-0.16
	No	3.0	1.00			0.00		
Maternal prenatal street drug use	Yes	2.5	1.04	0.84	1.27	0.04	-0.17	0.24
	No	3.0	1.00			0.00		

Source: Vital Statistics Birth, Stillbirth, and Death Files, Service Alberta, November 2006 release.

Notes: 1. Adjusted odds ratio (OR). OR is significant when the confidence interval does not include 1.

2. Log odds ratio (Log_e OR). Log_e OR is significant when the confidence interval does not include 0.

Data include Alberta residents only.

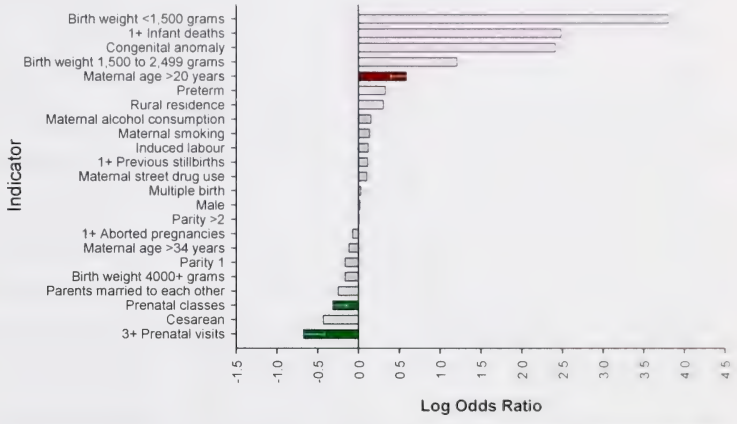
Data may differ from previously published data due to differences in definitions and dates of data extraction.

4 RESULTS

4.3 Infant Deaths

In this analysis, the odds of infant death for each of the maternal and infant indicators were looked at. The Birth Registration file contains a code for those births in which a death was registered prior to one year of age. There were 1,877 infant deaths thus coded in the Birth Registration files between 1997 and 2004, out of a total of 304,161 live births during that time period, for an overall infant mortality rate of 0.62%.

Figure 2. Indicators of Infant Deaths, Alberta, 1997 to 2004



Source: Vital Statistics Birth, Stillbirth, and Death Files, Service Alberta, November 2006 release

Birth weight, previous history of infant death, and presence of congenital anomaly were the strongest indicators for infant death. (See Table 4.3.1; explanation of figure conventions appears in Section 2.2.2).

For infants weighing less than 1,500 grams at birth, the odds of infant death were more than 45 times greater than for infants of "normal weight" (2,500 to 3,999 grams). For infants 1,500 to 2,499 grams, there was more than a threefold increase in infant deaths relative to the reference category. Infants with mothers who had another infant die have 12 times the odds of dying compared with infants whose mothers have not experienced an infant death; the rate of infant death among infants with mothers who have experienced a previous infant death is 13.8%. The odds of death prior to one year of age were more than 11 times greater for an infant with a congenital anomaly than for an infant without an anomaly. Preterm birth and rural residence (likely a proxy for lower socioeconomic status) were also both associated with increased risk of infant death.

4 RESULTS

4.3 Infant Deaths
(continued)

Potentially modifiable factors with significant effects on the odds of infant death included increased risk for young maternal age (under 20 years), and decreased risk in the case of three or more prenatal visits and attendance at prenatal classes. Cesarean sections were associated with decreased risk of infant death, highlighting the lifesaving role this procedure can have.

There were also small protective effects of having parents who were married to each other (likely a proxy for somewhat older maternal age and higher socioeconomic status) and parity of one, meaning that first time mothers were slightly less likely to have an infant die than second time mothers (the reference category).

Because of the relatively small sample of infant deaths (fewer than 2,000), statistical power was lower in this analysis than in the others in this report. The result is larger confidence intervals, and reduced chance of statistical significance in general. Thus several indicators had small but insignificant effects. For example, maternal prenatal alcohol consumption, smoking, and street drug use all had odds ratios of substantially more than one (between 1.11 and 1.17), but the small sample size meant these effects were not significant. Similarly, high birth weight and maternal age of 35 or older had odds ratios of 0.85 and .089 (lower risk of infant death), respectively, but these ratios were not significantly below one.

Overall, good prenatal care and avoidance of very early childbearing (prior to 20 years of age) are the most likely targets for programs aimed at prevention of infant deaths. Obviously, any measures which reduce the likelihood of low birth weight and congenital anomaly can be expected to reduce infant mortality as well.

Table 4.3.1. Rate, Adjusted Odds Ratios and Confidence Intervals, and Log Odds Ratios and Confidence Intervals for Infant Deaths (n_{case}=1,877) in Live Births (N=304,161), by Infant and Maternal Indicators, Alberta, 1997 to 2004

Indicator	Category	Rate (%)	OR[1]	Lower 95% CI	Upper 95% CI	Log_e OR[2]	Lower 95% CI	Upper 95% CI
Sex	**Male**	0.7	1.02	0.92	1.13	0.02	-0.08	0.12
	Female	0.6	1.00			0.00		
Rural residence	**Yes**	0.8	1.36	1.21	1.56	0.31	0.19	0.44
	No	0.6	1.00			0.00		
Multiple birth	**Yes**	2.7	1.03	0.86	1.23	0.03	-0.15	0.21
	No	0.6	1.00			0.00		
Preterm birth	**Yes**	4.5	1.40	1.14	1.71	0.33	0.13	0.53
	No	0.3	1.00			0.00		
Birthweight group	**<1,500 grams**	26.7	45.36	36.27	56.73	3.81	3.59	4.04
	1,500 to 2,499 grams	1.6	3.35	2.74	4.10	1.21	1.01	1.41
	2,500 to 3,999 grams	0.3	1.00			0.00		
	4000+ grams	0.2	0.85	0.67	1.08	-0.16	-0.40	0.08
Congenital anomaly	**Yes**	7.2	11.22	9.96	12.65	2.42	2.30	2.54
	No	0.4	1.00			0.00		
Maternal age (years)	**<20**	1.2	1.80	1.49	2.16	0.59	0.40	0.77
	20 - 34	0.6	1.00			0.00		
	>34	0.7	0.89	0.77	1.04	-0.12	-0.26	0.04
Parity	**1**	0.5	0.85	0.74	0.97	-0.16	-0.30	-0.03
	2	0.6	1.00			0.00		
	>2	0.8	1.01	0.88	1.16	0.01	-0.13	0.15
Marital status of parents	**Married to each other**	0.5	0.78	0.69	0.89	-0.25	-0.37	-0.12
	Not married to each other	0.9	1.00			0.00		
Number of previous aborted pregnancies	**1+**	0.7	0.93	0.83	1.05	-0.07	-0.19	0.05
	0	0.6	1.00			0.00		
Number of previous stillbirths	**1+**	1.7	1.12	0.87	1.46	0.11	-0.14	0.38
	0	0.6	1.00			0.00		
Number of previous infant deaths	**1+**	13.8	11.99	10.10	14.23	2.48	2.31	2.66
	0	0.5	1.00			0.00		
Number of prenatal visits	**3+**	0.4	0.51	0.40	0.66	-0.67	-0.92	-0.42
	<3	1.3	1.00			0.00		
Attendance at prenatal classes	**Yes**	0.2	0.73	0.61	0.87	-0.31	-0.49	-0.14
	No	0.7	1.00			0.00		
Onset of labour	**Induced**	0.6	1.13	0.99	1.30	0.12	-0.01	0.26
	Spontaneous	0.6				0.00		
Cesarean section	**Yes**	0.8	0.65	0.56	0.75	-0.43	-0.58	-0.29
	No	0.6				0.00		
Maternal prenatal smoking	**Yes, or quit during pregnancy**	0.9	1.15	1.00	1.32	0.14	0.00	0.28
	No	0.5	1.00			0.00		
Maternal prenatal alcohol consumption	**Yes**	1.0	1.17	0.91	1.49	0.16	-0.09	0.40
	No	0.6	1.00			0.00		
Maternal prenatal street drug use	**Yes**	1.5	1.11	0.82	1.50	0.10	-0.20	0.41
	No	0.6	1.00			0.00		

Source: Vital Statistics Birth, Stillbirth, and Death Files, Service Alberta, November 2006 release.

Notes: 1. Adjusted odds ratio (OR). OR is significant when the confidence interval does not include 1.

2. Log odds ratio (Log_e OR). Log_e OR is significant when the confidence interval does not include 0.

Data include Alberta residents only.

Data may differ from previously published data due to differences in definitions and dates of data extraction

4 RESULTS

4.4 Summary

In this population-level study of the predictors of multiple births and infant deaths in Alberta, we are reminded that adverse outcomes are the result of both preventable and non-preventable forces. The role of public health surveillance is to determine the role of identifiable and measurable risk factors so that prevention efforts can be mobilized when modifiable factors are found to play a role.

It would be valuable to attempt linkage of additional data sources (such as maternal pre-existing conditions and pregnancy complications) to the current database, in order to extend the findings to these important factors. Linkage to infant outcomes in later life would be informative as well.

Analysis of 9,075 multiple births made it clear that multiples are very often low birth weight or preterm or both, and these factors are associated with the much increased burden of mortality and morbidity faced by multiples. Mothers who give birth to multiples receive higher levels of interventions such as induced labour and cesarean sections, and receive more prenatal care on average than mothers giving birth to singletons. While these findings are not the results: More than one in four low birth weight infants and one in five preterm infants is a multiple, although multiples make up only 3% of all live births. While all multiple births certainly do not result in adverse outcomes, a large physical, psychological, and economic burden is being borne by multiples and their families as a result of the high rates of low birth weight and preterm birth in multiples.

The findings show that avoidance of delayed childbearing can help reduce the risk of multiple birth, in concert with avoidance of fertility treatments that result in multiple fetuses. A clear need for further study of multiple births exists, including the roles of reproductive technologies, congenital anomalies, and previous history of infant death.

Infant deaths, like multiple births, are strongly associated with low birth weight (especially <1,500 grams), but congenital anomalies and mother's previous history of infant death play important roles.

Increased risk of infant death is associated with teen births, and good prenatal care (prenatal visits with physicians and midwives) is associated with reduction in the odds of infant death. Other obvious areas for modification include reducing low birth weight rates and the incidence of preventable congenital anomalies.

4 RESULTS

4.4 Summary

The morbidity and mortality associated with multiple births can be significantly reduced if the rates of delayed childbearing and the use of fertility treatments are lowered. Education of women of childbearing age and health care professionals about these risk factors is crucial. A survey of Alberta women who had recently delivered their first liveborn infant showed that only one quarter of women were aware that the risk of multiple birth increases with maternal age, and only 37% of respondents exhibited a reasonable knowledge of risks associated with maternal age.[4] Career and professional support for women to who may not wish to delay childbearing, but feel pressure of one kind or another to do so, may also help reduce delayed childbearing.

Some infant deaths are preventable. Infant deaths occur more often to teenage mothers than older mothers. Widely available teen pregnancy prevention programs may reduce teen pregnancy rates. Universally accessible, available, and affordable prenatal care may help identify and deal with risk factors for infant death.

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